

Slow and Fast Light, Phase I

Completed Technology Project (2015 - 2015)



Project Introduction

In response to the NASA Small Business Innovation Research (SBIR) Program 2015 Phase I Solicitation S3.08: Slow and Fast Light, Torch Technologies in partnership with Ducommun Miltec proposes polarization-coupled fast-light optical gyroscope (FLOG) technologies to enhance the gyro sensitivity which would lead to an increase in the precision of inertial navigation systems resulting in greater spacecraft autonomy. The primary objective of this research is to develop the fast-light enhanced optical gyroscopes in a coupled cavity scheme to remove the necessity of using an atomic medium to produce the required anomalous dispersion. Producing fast light in a coupled cavity system is not a simple proposition, however, because it requires the stabilization of one cavity to the other due to the inherent presence of independent amounts of noise and drift in each optical cavity. In addition, no simple way to control the cavity scale factor exists in this scheme. Our proposed innovation is a new method of fast light cavity enhancement that implements mode coupling between orthogonally polarized modes in a single cavity as an alternative coupled cavity approach. The use of both polarization modes in the cavity result in common mode rejection of the noise and drift, resulting in a stable relative mode detuning and provides a simple control mechanism for the scale factor by rotation of the polarization, which is reproducible and stable. The results of this effort will contribute to development of gyroscopy technologies feasible for flexible path and deep space exploration to advance significantly current navigation systems.

Primary U.S. Work Locations and Key Partners

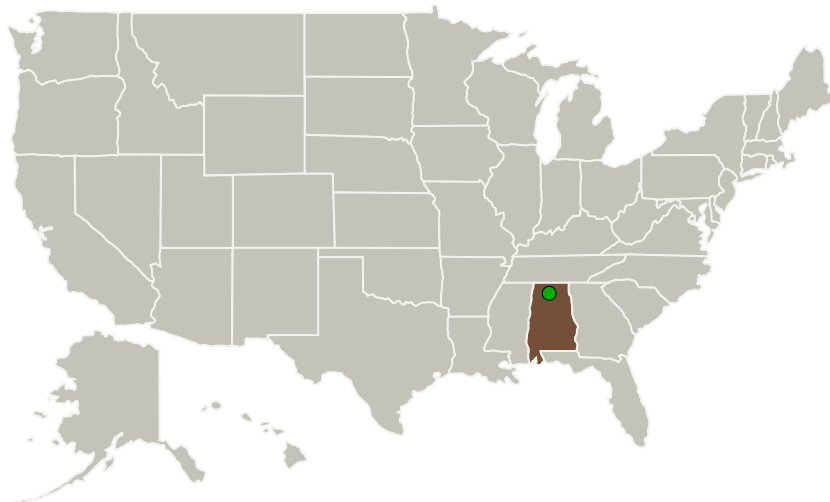


Illustration of how the response of a gyroscope is enhanced by fast light. The cavity modes are split by the rotation of the gyro. In the fast light region the refractive index n decreases with frequency ω , which pushes on the modes and further increases the splitting.

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Organizations Performing Work	Role	Type	Location
Torch Technologies, Incorporated	Lead Organization	Industry	Huntsville, Alabama
● Marshall Space Flight Center (MSFC)	Supporting Organization	NASA Center	Huntsville, Alabama

Primary U.S. Work Locations

Alabama

Project Transitions

▶ **July 2015:** Project Start

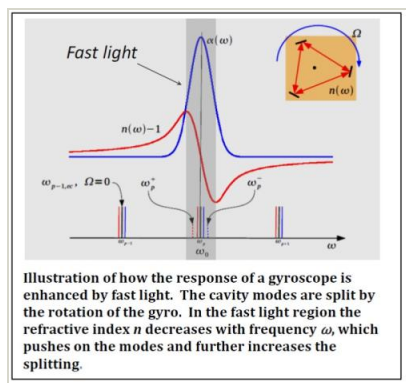
✓ **December 2015:** Closed out

Closeout Summary: Slow and Fast Light, Phase I Project Image

Closeout Documentation:

- Final Summary Chart Image (<https://techport.nasa.gov/file/139462>)

Images

**Briefing Chart Image**

Slow and Fast Light, Phase I
(<https://techport.nasa.gov/image/132676>)

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Torch Technologies, Incorporated

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Principal Investigator:

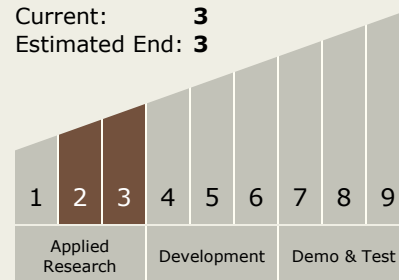
Brian M Robinson

Technology Maturity (TRL)

Start: **2**

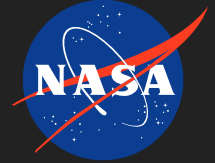
Current: **3**

Estimated End: **3**



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Technology Areas

Primary:

- TX17 Guidance, Navigation, and Control (GN&C)
 - └ TX17.2 Navigation Technologies
 - └ TX17.2.3 Navigation Sensors

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System